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Black-Headed Budworm

By W. F. McCambridge¹ and G. L. Downing²

The black-headed budworm (*Acleris variana* Fernald) is a defoliating insect that occurs from the west coast to the east coast of North America and periodically causes extensive defoliation of several species of fir, hemlock, and spruce. Under conditions most favorable for budworm development, trees of all age classes may be completely killed, top-killed, or suffer a reduction in annual growth. Many trees that

survive are left so weakened by heavy defoliation that they become easy prey to bark beetles and wood borers.

Large-scale outbreaks, sometimes covering millions of acres, have occurred periodically in the Pacific Northwest, British Columbia, and coastal Alaska since at least the 1920's and no doubt earlier. Lesser outbreaks have occurred in the Montana-Wyoming area of the Rocky Mountains and in several areas in eastern Canada and north-eastern United States.

Defoliation by the black-headed budworm has at times been accompanied or immediately followed by

¹ Entomologist, Rocky Mountain Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture, Ft. Collins, Colo.

² Entomologist, Alaska Forest Research Center, Forest Service, U.S. Department of Agriculture, Juneau, Alaska.



FIGURE 1.—Distribution of the black-headed budworm in North America.

epidemics of one or more of such defoliators as the hemlock sawfly, the hemlock looper, and the spruce budworm.

Host Trees

With the range of the black-headed budworm extending as it does from the Atlantic to the Pacific, several species of trees fall victim to defoliation by this insect (fig. 1). In eastern Canada and northeastern United States balsam fir is the preferred host with white and sometimes red and black spruce being defoliated during budworm epidemics. In western North America western hemlock is the preferred host, but defoliation may also occur on Pacific silver fir (*amabilis* fir), Douglas-fir, alpine fir, grand fir, Sitka spruce, Engelmann spruce, and mountain hemlock.

Evidence of Infestation

Epidemics of the black-headed budworm frequently spread quickly over large areas so that forests

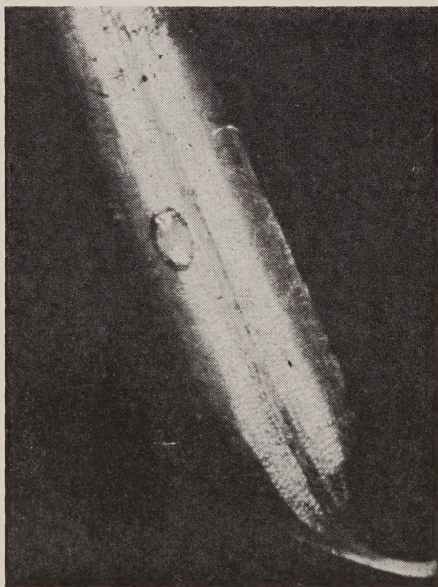
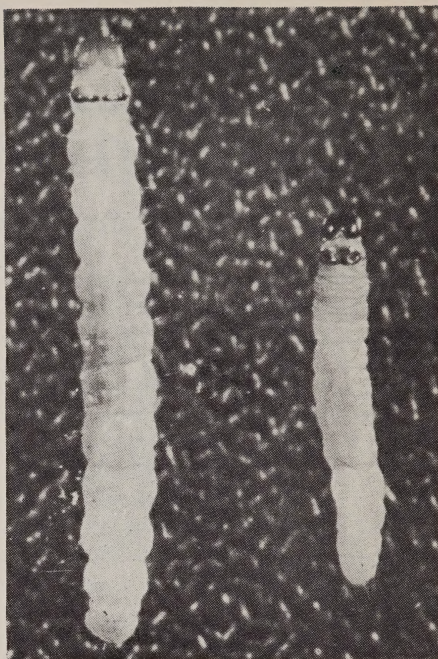


FIGURE 2.—Black-headed budworm egg.
(Photo by Forest Biology Laboratory, Canada
Department of Agriculture, Victoria, B.C.)



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FIGURE 3.—Immature larva with dark head,
mature larva with light head.

which appear green and healthy one year may the next be reddish brown as if scorched by fire. This discoloration, which in any one year becomes most prominent in late June and July, is due to the partially eaten and damaged needles. These needles cling to the twigs or are held in place by webbing produced by the budworm.

The budworm shows a strong preference for the new foliage, which results in the exposed portions of the trees being the first to exhibit symptoms of attack.

Unless defoliation has been severe enough to kill the tops of the host trees, the forests gradually regain their normal appearance, and within a few years after an epidemic it is hard to find evidence of previous damage.

Description

The black-headed budworm belongs to the moth family and in



FIGURE 4.—Black-headed budworm pupa.
(Photo by Forest Biology Laboratory, Canada
Department of Agriculture, Victoria, B.C.)

common with others in the family progresses through four distinct stages during its life. These stages are: (1) the egg; (2) the larva, which causes the damage; (3) the pupa, or resting stage; and (4) the adult moth. The eggs are yellow, about $\frac{1}{32}$ of an inch long, oval, and slightly flattened (fig. 2). Immature larvae are pale yellow with black heads, but as they grow larger the body tends to become green. When full-grown the larvae are slender, $\frac{1}{2}$ inch or more long, yellow-green to green, and the head is light brown (fig. 3). Pupae are brown or greenish brown and somewhat leathery in appearance. They taper gradually toward the tail end, and are between $\frac{3}{8}$ and $\frac{1}{2}$ inch long (fig. 4). Close scrutiny of the pupa will disclose the outlines of wings and other parts which the emerging moth will possess. The adult moths are predominantly mottled gray with various brown, white, or gray

ragged bands extending across the wings (fig. 5). Some have a white, yellow, or orange stripe down each wing, and some have a yellow or orange "cape" near the head. The moth in normal resting position is about $\frac{3}{8}$ inch long and $\frac{1}{4}$ inch wide.

Life History and habits

The black-headed budworm completes its life cycle in 1 year. Local seasonal temperature variations and differences in elevation may advance or retard development considerably but, in general, the following is representative of the development of the budworm throughout its range. Eggs are laid, by the female moths, singly on the underside of needles during August and September. This takes place predominantly in the upper crown of the host trees. The winter is spent in this stage. In late May and early June the tiny larvae hatch from the eggs and burrow into the expanding buds. As the new foliage continues to grow, the larvae web together a few needles and feed in concealment. When the supply of new needles has been devoured, the budworm is forced to move to the older foliage. The entire feeding period requires from $1\frac{1}{2}$ to 2 months, at the end of which



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FIGURE 5.—Variation in markings of black-headed budworm adults.

time the larvae transform into pupae. Pupation takes place on the tree within clusters of partially eaten and damaged needles webbed together by the full-grown larvae. During the pupal stage, which lasts from 10 days to more than 2 weeks, transformation to the moth takes place. Moths begin emerging in late July and become most numerous in August and September. Shortly after emerging the moths mate, lay eggs, and then die; thus, completing the life cycle.

Natural Control

The budworm has many natural enemies which help to keep it under control during most years and in most areas. One species of parasitic wasp no bigger than a speck of dust has destroyed up to 25 percent of the eggs in some areas. Parasitic flies and wasps may become very abundant, killing up to 85 percent of the mature larvae and pupae. From time to time budworm populations, within restricted areas, have been destroyed by a virus disease. Unfortunately, such enemies as parasites and disease do not always prevent the occurrence of outbreaks and during outbreaks they generally do not become effective until much damage to the trees has occurred. Other less important or little known natural control agents are ants, spiders, birds, and weather.

Chemical Control

In the past satisfactory control methods were not available for use against this insect, and as a result control of outbreaks was not attempted. Within recent years outbreaks of other similar defoliators have been successfully controlled by aerial applications of DDT.

The success of these aerial spray programs led to the use of DDT against outbreaks of the black-headed budworm in Montana and British Columbia in 1957. Results obtained in these programs indicate that DDT applied from the air when the budworms are in the larval stage will suppress outbreaks over large forested areas. A recommended spray formulation consists of 1 pound of technical DDT in 1.25 quarts of an auxiliary solvent added to No. 2 fuel oil to make 1 gallon. This spray formulation should be applied at the rate of 1 gallon per acre. This dosage may cause loss of fish if it contaminates lakes or streams; therefore, specialists should be consulted before spraying areas containing important fish populations.

For ground application involving small areas or ornamental trees the use of oil solutions should be avoided because of the danger of causing foliage burning. For this type of spraying water soluble DDT is suggested.

Caution: DDT is poisonous and should be used with due precautions. Store in a safe place, away from food, and correctly labeled.

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